Surface tension of liquid

Aim:

Aim is correctly written and relevant to the experiment.

To investigate the effects of types of liquid and temperature on surface tension of water.
or
To investigate how types of liquid and temperature affects the surface tension of water

Hypothesis:

The predicted outcome of the experiment is that water will have a greater surface tension than any other kinds of liquids such as milk or water mixed by milk.

Scientific explanation for the hypothesis

Therefore, water should have the greatest droplets of liquid on a surface of coin. Water molecules should have the strongest cohesion forces. This is because it has high boiling point - 100 C.

Independent variables:

Independent variables are variables that can be changed throughout the experiment. The independent variable in this experiment is the

1) different kinds of liquid that is going to be tested on the coin to find out its surface tension.
2) temperature of solutions.

Student showed how types of liquid or solutions are changed – independent variable

Types of liquid or solutions used are:
a) water
b) water and milk solution mixed in 1:1 ratio
c) salt water solution - 1/2 teaspoon salt mixed in 150ml water
d) water, milk and salt solution - water and milk mixed in 1:1 ratio and 1/2 teaspoon of salt added and mixed.

Student showed how temperatures of solutions are changed – independent variable

The following solutions were heated to 30, 40 and 50 degrees celsius, using hot plate:
hot water, milk and milk and water (mixed in ratio 1:1)

Dependent variables:

Dependent variables are what you measure throughout the experiment and we are measuring how many drops of different liquid could be fitted onto one side of the coin. The side of the coin used is the 'head' of the coin.

It's important here to ensure that the period between drops are consistent, drops are made with steady hands.

Controlled variables:

Controlled variables are what you can do to ensure that the experiment is fair and accurate.

1. Clean and dry the coin after testing one type of liquid, because the previous liquid's substance could still be remained on the coin.
2. The height between a dropper and the surface of coin should be fixed, say 1 cm apart. The height can be fixed using retort stand and clamps. Drops are also made at the centre of the coin.

Apparatus:

1. Beaker (150 ml) : Used for holding each liquid or mixing different kinds of liquid together.
2. Dropper: Used for dropping droplets on the coin.
3. 1/2 tea spoon: Used for adding salt to the 150ml liquids and stirred of even mixing.
4. Hot plate: Used for heating up the liquid. Temperature of hot plate is set at 200 C.
5. Retort stand and clamp.

Materials:

1. Water (150 ml): Used as one of the liquid tested to find out its surface tension.
2. 100 yen coin: Used for finding out the surface tension of each different kinds of liquid by dropping droplets of liquid on the coin. (It could also be a different kind of a coin, but have to use the same coin for every experiment with different liquids)
3. Milk (150 ml): Used as one of the liquid tested to find out the it's surface tension.
4. Salt: Used for more extended experiments by adding salt to the liquid to find out the effects of salt on the surface tension of each liquid. (optional).
5. Tissue paper: Used for drying the coin.

Method is repeatable and doable.

Method:

1. Draw a table to record the results. Assemble all apparatus on the table. Example:

Types of liquid	Number of drops
Water	32
Milk	60
Water and milk	20

2. Get a 100 yen coin and put it on a flat surface. (optional to put a tissue paper underneath the coin)
3. Pour the liquid on a beaker (milk, water, and water + milk mixed) that was chosen to be observed.
4. Start by using the dropper to drop 1 drop of liquid onto the surface of the coin.
5. Continue adding more drops by counting the drops as putting more in.
   Example: 1, 2, 3, 4, 5..... Etc.

Student is specific to what is recorded.

6. When the first liquid starts to leak out, stop dropping droplets. Record the amounts of droplets fitted onto the coin. Observe surface tension formed and record observation.

7. When ready to move on to the next experiment using other liquids, clean and dry the apparatus used so that the experiment is fair.

8. Restart the experiment from procedure 3 to 7 using a different liquid.

Experiment is repeated 3 times for accuracy

9. Experiment is repeated 3 times so average can be calculated.

Data collection:

Table is titled

Table below shows the average amount of droplets recorded at various temperatures of liquids and types of liquid

Table has proper headings and units of measurement (amount of droplets)

Experiment 1: cold liquid	Type of liquid	Trial 1: amount droplets	Trial 2: amount droplets	Trial 3: amount droplets	Average
	Cold water	34	34	33	34
	Cold milk	32	35	44	37
	Cold water & milk	25	26	25	25
Experiment 2: hot liquid (50 C)	**Type of liquid**	**Trial 1: amount droplets**	**Trial 2: amount droplets**	**Trial 3: amount droplets**	**Average**
	Hot water	27	32	37	27
	Hot milk	41	48	43	44
	Hot water & milk	30	26	25	27
Experiment 3: Liquid with salt (1/2 tsp)	**Type of liquid**	**Trial 1: amount droplets**	**Trial 2: amount droplets**	**Trial 3: amount droplets**	**Average**
	Cold water & salt	36	47	39	41
	Cold milk & salt	44	39	40	41

Experiment 1: cold liquid	Type of liquid	Trial 1: amount droplets	Trial 2: amount droplets	Trial 3: amount droplets	Average
	Cold water & milk &salt	25	27	26	26

Also called as qualitative data

Observation:

- When I added the water and the milk together the color of the liquid was a lighter white then the color of the milk.
- To each liquid on our 3rd experiment we444 added 1/2 teaspoon. There wasn't any effect on the color change of liquids.
- When the liquid was dropped onto the coin it didn't produce any bubbles.

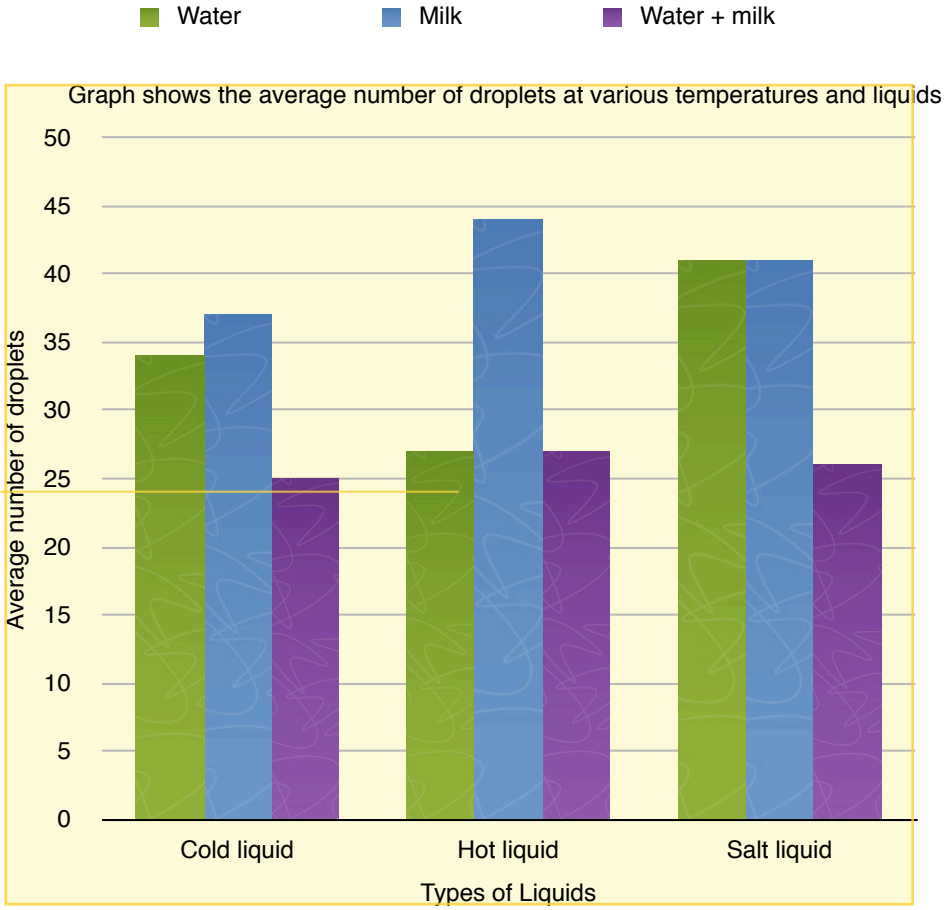
Student shows how average is calculated

Average for number of droplets is calculated using:

$$\frac{\text{Trial 1} + \text{Trial 2} + \text{Trial 3}}{3}$$

= Answer (rounded to the nearest whole number)

Data processing:



Titled, labelled and only averaged data is being used

Pattern or trend:

1. Milk had a greater surface tension than water because it held more droplets.
2. Water + milk had the least number of droplets - the least surface tension.
3. Adding salt:
   - Adding salt to water, it decreased it's surface tension.
   - Adding salt to milk increased it's surface tension.
   - Adding slat to water + milk increases it's surface tension.
4. Heated, cold, and salted milk + water didn't have much difference.

Conclusion:

Debunking hypothesis
Scientific reasoning

As shown on the table and graph above, milk had a greater surface tension than the water, the hypothesis predicted was incorrect. It is possible that milk molecules adds to the cohesiveness between water molecules.

Confirming hypothesis

The 2nd predicted outcome of the experiment was that the cooler the liquid is the stronger the surface tension would be. The hypothesis is proven true. After boiling the liquids into 50 Celsius it had a different result from the cold liquid. For example after boiling the water, the average of droplets fitted onto the coin has decreased by 7 drops, which means that cold water has a greater surface tension then hot water.

Scientific reasoning

How can I explain this? When temperature is increased, energy is added to the cohesion forces between water, weakening it.

Mixing 2 different kinds of liquid had the least surface tension, for example mixed hot water and milk together had a result of 27 drops but the hot milk itself held 44 droplets. Adding salt to water and milk increased the surface tension but it did not have any effect on mixed liquid which was water + milk. Most interesting fact is that the stronger the forces of molecule, there is greater cohesion.

Evaluation:

Evaluation is practical and logical. It is possible that implementing these can improve the experiment

1. A hair drier should be used so that the coin is completely dried for the next experiment, so that the substances on the liquid is not remained on the coin. Coins are dried using intense heat for 2 minutes.
2. Using the clamp stand and the base for keeping the dropper steady could have helped to get a more reliable result compared to using hand to keep the dropper steady.
3. Cleaning all the apparatus completely after using, so that the substance of the previous liquid wouldn't be remained on any apparatus. Coins are first cleaned using soap and rinsed using water.
4. Is the surface of the table even? If it's not, surface tension might be shifted a corner of a coin and this affects the results.